AGRICULTURAL Research

U.S. DEPARTMENT OF AGRICULTURE

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AGRICULTURAL
Research

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A Critical Challenge

Dealing with pollutants is one of today's toughest technological challenges: planet earth is a closed system with limited natural processes for waste disposal.

Much of this challenge must be borne by agricultural research for agriculture is both sinner and sinned against. Agricultural activities produce sediment, manure, and processing by-products which enter streams. In turn, industrial smoke and auto exhausts harm crops and timber. Moreover, pollutants are frequently linked in a cycle. An airborne pollutant from industry may settle on soil surface, then percolate through the soil into ground water or a stream. Interactions between pollutants and their sources are incredibly manifold. Although agriculture's contribution is increasing, the bulk of pollutants produced in our society comes from sewage and industrial wastes.

Pollution control is not a new challenge to agricultural research. Since 1888, when USDA successfully imported an insect ally to pit against the citrus scale, it has actively pursued this nonchemical approach to insect control. The Pure Food and Drug Act of 1906, which bars contaminants from food, was conceived by Dr. H. W. Wiley, chief chemist of USDA. ARS research on pesticide residues and on safeguarding soil from the ravages of wind and water goes back several decades.

Today's pollution fighters provide evidence that nonsoluble materials, such as phosphates, are so bound by soil particles that they move only as the particles move. Thus practices which prevent erosion will curb this type of pollution. And paralleling the recycling of decayed materials in nature, ARS scientists devised methods for salvaging wastes, turning poultry feathers and citrus pulp into feeds and whey into confections.

Research will continue to play a vital role in coping with the national pollution problem. But the public has a responsibility too. There is a need for broader ecological awareness, so that we can weigh the consequences of environmental actions. Concerned citizens can create a climate in which leaders and institutions make environmental decisions based on a wealth of accrued facts. Pollution must be curbed—without hampering the world-wide effort to grow more food. The issue involves every citizen. We are the stewards of our natural resources.

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Clifford M. Hardin, Secretary
U.S. Department of Agriculture

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Seed cells in nutrient multiply 24 hours, being transplanted each 8 hours as their volume increases from 1/3 quart to more than 2½ gallons. Cells are then harvested and processed to obtain the L-asparaginase above (PN–1793).

'Gardening' a Cancer Inhibitor

GROWING BACTERIAL CELLS and extracting leukemia-inhibiting L-asparaginase is like home gardening—ARS scientists plant, transplant, harvest, and process.

Chemist R. E. Peterson and microbiologist Alex Ciegler are growing crops of *Erwinia aroideae* cells, which they recently found to be a high-yielding source of the enzyme, L-asparaginase.

L-asparaginase breaks down the amino acid, L-asparagine, to simpler compounds. Destroying the amino acid inhibits the growth of leukemia cells but does not affect normal cells. Most leukemia cells need the amino acid but, unlike normal cells, cannot make it.

Medical scientists consider L-asparaginase a promising agent for treating acute leukemias and possibly other kinds of cancer. The enzyme has given complete remission of some kinds of human leukemia in clinical tests. Although it is found in many kinds of cells, not enough of it has been available for extensive testing.

In addition to studying production of L-asparaginase by *E. aroideae* cells, the ARS scientists are producing small quantities for testing by organizations such as the National Cancer Institute, Washington, D.C.

This ARS work not only makes more of the enzyme available for antileukemia studies but also provides an L-asparaginase that is different from what was available. L-asparaginase from *E. aroideae* might help leukemia patients who are immune to the enzyme from other sources or who develop reactions like hives.

The scientists' "garden" includes eight 20-liter (about 20 quarts) fermenters in the pilot plant at the Northern utilization research laboratory, Peoria, Ill. Their nutrient medium, instead of soil, is a water solution of partly digested protein (tryptone), corn sugar (glucose), yeast extract, and minerals (potassium phosphate).

They start with test tube quantities of *E. aroideae* seed cells; perform at least 20 distinct operations in about 60 hours to grow and harvest a crop of cells; then extract the L-asparaginase.

Fast by gardening standards, lab production of L-asparaginase seems slow when measured against the need. ■

Left: The problem (PN–1794). Above: Material removed by chamber after processing nine bales of machine-picked and three bales of machine-stripped cotton. Air wash operated about half the time (PN–1795).

Clean air 'round the cotton gin

When you see clouds of dust in the air, you know the gin is running, people in cotton country will tell you.

But not much longer. For ARS agricultural engineer J. B. Cocke has designed a simple system to control air pollutants emitted by gin plants.

The shift to mechanical harvesting has increased the amount of trash in cotton delivered to gins and consequently increased pollution. At the same time, the establishment of air-quality standards and the increasing urbanization near formerly isolated gin plants make air pollution control more urgent. Available pollution-control devices developed for industry are either not adapted to ginning plants or their cost is prohibitive.

The inertial separation chamber that Cocke built at the Southeastern Cotton Ginning Research Laboratory, Clemson, S.C., provides an inexpensive way to trap lint fly, dust, and trash otherwise discharged into the air by the gin's unloading fan.

The separation chamber is placed to receive the gin exhaust, which enters the chamber at the top of the front panel. The exhaust moves in a serpentine flow pattern under the first baffle, over a second, and under a third to an outlet at the top of the rear panel. As it flows through the chamber, the velocity of the air stream is reduced, causing some pollutants to settle out. Additional airborne material is deposited by an air wash system that delivers 70 gallons of water per hour through three flat spray nozzles equally spaced over the inlet and six cone nozzles on the top and sides of the chamber.

The chamber floor slopes from the center to drains that discharge water and collected material at each end. In addition, sliding doors on chamber sides permit periodic flushing and cleaning with a garden hose.

Without the air wash system, Cocke's tests showed that the separation chamber removed principally large and heavy particles, such as sand, sticks, and parts of leaves and seeds, but much of the finer trash passed through the chamber to pollute the air.

Adding the air wash system reduced particle discharge from the chamber 44 to 92 percent, depending upon crop year and time and method of harvesting the cotton being ginned. One-half inch or more of trash accumulated on interior surfaces, and little dust, lint fly, or large particles were discharged.

Reduction of air velocity by the chamber also caused a high percentage of the pollutants not removed to settle to the ground nearby. On a windless day, the amount of material deposited below the outlet was 27 times as great as that 8 feet away. When wind blew at 10 to 15 miles per hour, almost twice as much material settled in front of the chamber as 8 feet away.

Cocke has prepared design specifications for inertial separation chambers for use in gin plants with discharge volumes ranging from 2,000 to 20,000 cubic feet per minute. And people living near a gin equipped with one of these chambers are sure to breathe easier. ■

Meadowfoam: Beauty plus Utility

MEADOWFOAM (*Limnanthes*), presently grown only as an ornamental plant, is a promising new source of industrial oil in the United States.

ARS researchers have found that the seed contains 20 to 30 percent oil and about 21 to 34 percent crude protein.

The oil has exceptionally long-chain fatty acids that can easily be converted into a high-grade liquid wax similar to jojoba and into a solid wax like carnauba and candilla. Jojoba is used to make such products as lubricants, furniture polish, and automobile wax. The solid waxes go into the manufacturing of candles, shoe polish, varnish, phonograph records, and various polishes for home and industrial use.

The protein of the meadowfoam seed contains lysine and methionine in quantities comparable to those in legumes, indicating that the meal may be used as a feed component for livestock.

Agronomically, meadowfoam is a potential cash crop for farmers. It is best adapted for growing as a winter annual in regions with high moisture and mild winters such as western Oregon and Maryland, and as a spring annual in northern areas of the Midwest and in parts of Alaska. Since it is a winter annual, it is well suited to double or rotational cropping. It matures early enough in the season to permit production of summer crops such as corn and soybeans.

A relative of the geranium, meadowfoam is native to California and Oregon. In bloom, it displays a mass of showy, moderately-sized, white, yellow, to pink flowers. The most favorable soil temperatures for germination range from 40° to 60° F.

Promising as the plant is, it is not without problems. ARS and State researchers in Oregon, Alaska, and Maryland are attempting to improve yield, seed retention, and uprightness. The growing habits of the various species of the plant differ, ranging from prostrate to upright and about 7 inches tall.

Of 30 varieties tested, five have outstanding yielding ability—*L. alba, alba* var. *versicolor, douglasii, douglasii* var. *nivea,* and *gracilis* var. *parishii.* In field experiments, yields of 2,000 pounds an acre have been attained. But this represents a maximum experimental yield. All varieties except *L. alba* have poor seed retention, which makes harvesting of all the seed produced very difficult. According to ARS plant physiologist J. J. Higgins who is conducting studies on *Limnanthes* at Glenn Dale, Md., improved seed retention, yield, and uprightness of the plant can be achieved through plant breeding. When this is accomplished, the plants will be suitable for mechanical production and harvesting.

Higgins also indicated that meadowfoam would probably gain popularity as an attractive ornamental if it were planted in the fall rather than in the spring in mild winter areas such as Washington, D.C. Fall-planted meadowfoam in such areas grows vigorously and flowers profusely whereas spring planting results in tiny plants with few flowers. ■

Meadowfoam grows wild in western United States. It is a beautiful, hardy annual when planted properly in the fall and grows best in full sunshine. Meadowfoam is also a good flower for bees (PN–1796).

Bacterial agents curb POULTRY LICE

Two preparations of a bacterial organism look like promising biological weapons against poultry lice, pests that weaken and sometimes kill chickens.

ARS entomologists R. A. Hoffman and R. E. Gingrich, Kerrville, Tex., dusted Leghorn hens with a commercial bacterial preparation containing *Bacillus thuringiensis.* After 2 weeks, only immature forms—the nymphs—of lice were found on the hens. Within 4 weeks, all lice had died from the toxic materials produced by the bacteria.

Bacterial dusts proved effective against shaft, wing, and body lice of chickens. Best results were obtained with chickens held in battery cages; it took longer to control lice when the treated birds were held on the floor of conventional poultry houses.

Gingrich also worked with exotoxin, one of the toxic materials produced by laboratory colonies of *B. thuringiensis,* and found it more effective than the commercial dust.

Exotoxins are produced in different quantities by various bacterial colonies, and studies indicate that at least two or three different types are formed. They are closely related to nucleotides, which carry the genetic instructions necessary for normal cell reproduction.

The active ingredient in exotoxin has been difficult to identify because the purified compound breaks down rapidly. Exotoxin products tested by Gingrich, however, have been identified in part as insoluble calcium salts. If the ingredient can be identified and synthesized, the synthetic product could be used, eliminating the need for maintaining bacterial colonies. At the same time, the quantity and quality of toxin produced could be controlled.

Exotoxin from one of the most productive bacterial colonies acted faster and with greater potency than the bacterial dusts tested originally. Only $\frac{1}{75}$ ounce of the exotoxin produced the same effects as about $\frac{1}{7}$ ounce of the bacterial dust tested earlier on hens infested with more than 150 lice per bird. The lice died on the chickens within 3 weeks after treatment with the exotoxin.

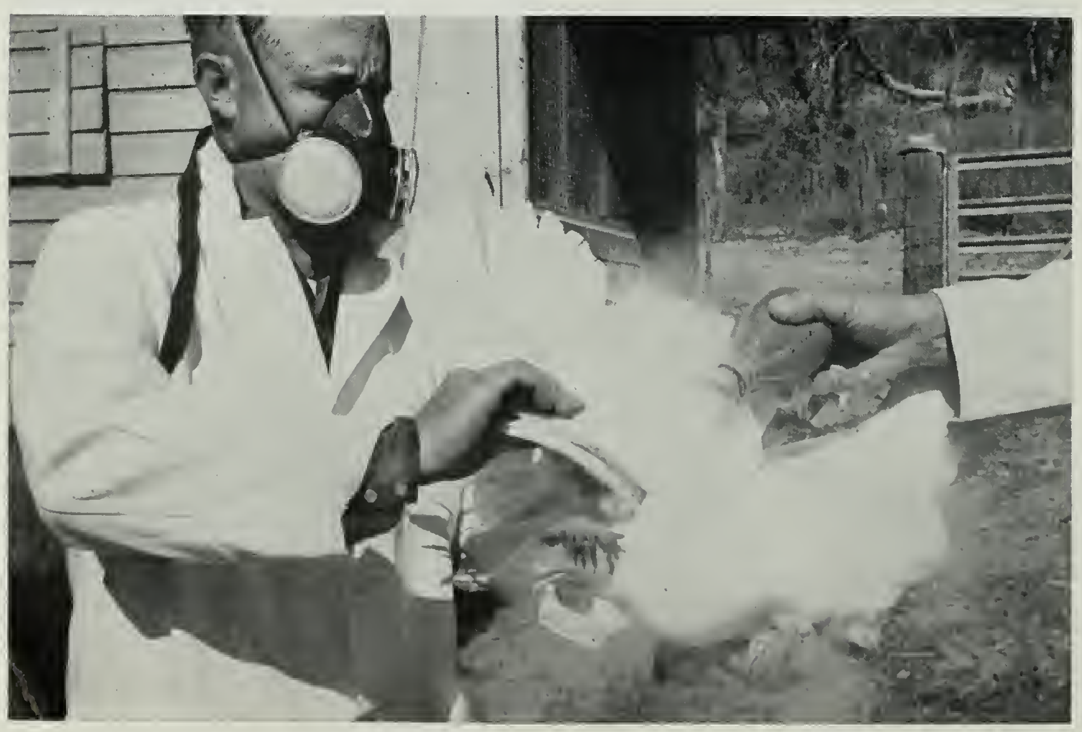
In addition, exotoxin treatments only around the birds' vent area proved as effective as bacterial dust treatments applied over larger areas of the birds' bodies. If equipped with a duster that directed the dust upwards, one man could treat a large number of birds with exotoxin much faster than conventional body dusting with the commercial bacterial preparation.

Although the way that the exotoxins act on lice hasn't been determined, the compounds may in some way interfere with, or garble, the genetic instructions essential for growth and development of the lice. More research will be needed to test this theory.

Scientists observed no side effects on poultry or warm-blooded animals from exotoxin or the commercial preparation.

Both exotoxin and the commercial preparation are experimental products not available at this time for practical use by poultry producers. ■

Technician B. F. Hogan spreads hen's wings as Hoffman dusts bird with bacterial spore preparation (PN–1797).



Grunes uses an atomic absorption spectrophotometer to analyze plant and blood samples for magnesium, calcium, and potassium. A polarograph is used to measure trans-*aconitic acid in the samples (PN–1781).*

Grass Tetany simulation tests indicate a cause

EXPERIMENTAL INDUCTION of tetany may have pinpointed an important cause of grass tetany, an often fatal poisoning of cattle pastured on lush grass or winter wheat.

The tetany closely resembles field cases of grass tetany and was induced by giving cattle equal amounts of potassium chloride and *trans*-aconitic acid by oral administration. The research was conducted in Reno, Nevada, by ARS and the Nevada Agricultural Experiment Station. Earlier, P. R. Stout and R. G. Burau at the California Agricultural Experiment Station noted high levels of *trans*-aconitate in early-season forage grass collected where severe outbreaks of grass tetany had occurred.

Discovering the cause of grass tetany would open the way for developing practical methods of prevention.

Animals affected by grass tetany poisoning initially show unusual excitement, incoordination, and loss of appetite. Unless treated, staggering, muscular contraction, coma, and death follow. Affected cattle usually recover if they receive an intravenous or intraperitoneal injection of calcium-magnesium gluconate in the first few hours after symptoms occur. Chance of recovery is slight if treatment is delayed 8 to 12 hours.

Animal nutritionists V. R. Bohman, A. L. Lesperance, and G. D. Harding of the Nevada station and soil scientist D. L. Grunes of ARS also induced tetany in cattle given equal amounts of potassium chloride and citric acid. Dietary citrate was known to produce lowered plasma magnesium, a condition associated with grass tetany.

The scientists say *trans*-aconitic acid (TA) is probably present in grass in chemical combination with potassium, as potassium *trans*-aconitate. They noted that TA, citric acid (CA), or potassium chloride (KCl) did not produce tetany when administered alone.

How the combination of TA, CA, and KCl brings on tetany is unknown. One possibility is that KCl may increase absorption of TA or CA from the digestive tract. The TA or CA could then combine with plasma magnesium or calcium, making these biologically unavailable and consequently inducing tetany.

The scientists did not succeed in producing tetany with KCl–TA or KCl–CA until the third of their five experiments indicated that the dosage needed to bring on tetany is related to the body size of the animal.

Tetany occurred—usually within an hour of treatment—in mature lactating cows given an average of 157 grams each of KCl and TA or like amounts of KCl and CA per 100 grams of body weight. Animals that did not show tetany received a dosage averaging 121 gm or less per 100 kg body weight. Two of four animals given KCl–TA and four of seven receiving KCl–CA exhibited tetany symptoms.

This observation was confirmed in a later experiment. Tetany occurred in animals given KCl–CA at 157 gm each per 100 kg body weight, and these animals responded to injections of calcium gluconate fortified with magnesium. A higher rate (195 gm per 100 kg) also produced tetany, but these animals did not respond to treatment. ■

View from Apollo 9: This color infrared photo of the California Imperial Valley was taken at 131 nautical miles altitude. The bright red patches are crops. Major task of this photo run was to find out how the agricultural scene would appear in the red, green, and infrared spectral bands. Another task is to identify species and to distinguish healthy from unhealthy crops. As Apollo 9 took this photo, conventional aircraft photographed the area at various altitudes using the same type of cameras (see photo p. 10) to provide similar information for later correlation (PN–1782). Cover: Infrared photos are taken from aircraft at Weslaco, Tex. Data from the ground are obtained simultaneously via lift. Such data, called "ground truth," correlate actual condition with aerial photo (ST–4780–5).

Below top: Technician at Weslaco compares microdensitometer chart of optical and color density variations in infrared film strip. The microdensitometer is more sensitive than the eye to subtle color variations that may indicate disease or other stress factor in crops (ST–4704–7). *Below bottom:* Radiation from the sun is recorded at ground level as instructions are given via radio from lift. These data will be compared with reflected radiation recorded by spectroradiometer in lift to obtain accurate information on amount of light absorbed, transmitted, and reflected by crops. (BN–33695. Color transparencies of all photos are available to news media.)

Pink areas on trees in infrared photo of citrus orchard indicate chlorosis due to soil deficiency. Soft brown scale disease of citrus would appear dark red or black in contrast to bright red healthy trees (BN–33694).

Infrared Magic

THE FIRST "SPACE STATION" for agricultural research may be orbited in 1972 or 1973.

The station, the first of the earth resources satellites to be sent up by the National Aeronautics and Space Administration, should hasten application of remote-sensing techniques to the management of agricultural and other natural resources.

For agriculture and forestry, each $1 spent on remote sensing research promises to return $5 in benefits, says A. B. Park, assistant to ARS administrator G. W. Irving,

A technician mounts four cameras into aircraft. The cameras, similar to those used in the Apollo 9, operate simultaneously. Each contains a specific type of film and filter to provide information in different spectral regions for more accurate detection of stress factors in growing crops (ST–4709–14).

Jr., and chairman of USDA's Research Management Group that defines research requirements for remote sensing.

Remote sensing promises to provide information that will help alleviate world hunger and improve man's environment through more efficient use of the world's land and water resources based on evaluations of potential and supply; reduced loss of crop and forest production by early identification of incipient disease or insect attack; and improved marketing and distribution of food aided by worldwide estimates of crop acreage and yield.

What is remote sensing? In general terms, it is getting information about things from a distance or about things one cannot touch—the physician's X-ray machine, the uranium prospector's Geiger counter, and the aircraft pilot's radar are examples.

Agricultural remote sensing gathers data in the ultraviolet, visible, infrared, and microwave regions of the electromagnetic spectrum. When the data obtained by a single sensor or combinations of sensors in aircraft or satellite is interpreted, it can provide information on vegetation, soil, and water infinitely faster and often more accurately than ground observation.

Radiation generated by the atomic and molecular activity of matter streams from every object in the universe. Only the radiation from a narrow band of the spectrum (red through violet visible light) can be detected by the eye or conventional photography. Ultraviolet energy travels in wavelengths shorter than man can see; infrared and microwave at wavelengths too long to be visible.

Somewhat oversimplified, agricultural remote sensing research involves three steps:

First, determining the part of the spectrum where differences in vegetation, soil, or water can be detected. For example, the temperature of a plant stressed by disease, insects, or salinity is higher than that of a healthy plant, and temperature differences are revealed in infrared images.

Second, identifying "spectral signatures" of contrasting objects or conditions. Each soil condition, every plant, and every body of water has unique and measurable reflectance and radiation characteristics. The signatures are models indicating how these characteristics relate to the physical or chemical properties of the radiating material. Each signature provides the "ground truth" for evaluating the information recorded by the sensors aloft.

Third, devising computerized techniques for interpreting and processing the data obtained by remote sensors and for furnishing the information in a form—photograph, computer printout, or statistical table—convenient to the ultimate user.

As USDA's science agency, ARS coordinates agricultural research on remote sensing at Purdue University, the University of Michigan, and the ARS station at Weslaco, Tex., as well as forestry and range research at the University of California, Berkeley, and Oregon State University. Current agricultural studies, other than some work at Weslaco, are funded by NASA.

Research is now carried out in laboratories, from 70-foot towers in fields, and from aircraft flying at 2,000 to 2,500 feet or higher. The next step will be use of aircraft at altitudes of at least 30,000 feet, where observa-

tions through 80 percent of the earth's atmosphere will simulate those from space. Early space flights at about 600,000 feet will have remote sensing systems covering an area of 100 by 100 miles on the ground in a single image.

Remote sensing research has progressed rapidly since ARS scientists first found that salt-affected soils in cotton fields can be detected on photos made with aerial infrared film and dark-red filter (AGR. RES., Aug. 1963, p. 8). By examining the photos, the scientists related shades of photographic tone to salinity levels previously determined by laboratory analysis of soil samples.

Now, the need for man to interpret the data is being reduced or eliminated as capabilities are developed for machine classification of large quantities of data.

In addition, scientists are using not only single sensors but combinations of devices in multispectral techniques. And they are employing devices that measure physical characteristics such as reflectance, emittance, and surface geometry of plants, soils, and water. Among the highly sophisticated devices in use are some that are classified for national security reasons by the Department of Defense.

Regardless of type of sensor used, the data obtained must be interpreted by matching against previously determined spectral signatures. Scientists are therefore building a data bank of increasingly precise information on the radiation characteristics of vegetation, soil, and water.

Nevertheless, scientists believe that previously determined signatures will require sharpening to match localized conditions at the time of each overflight. Perhaps signature information was obtained at another time of day, at a different stage of plant growth, or under another soil moisture condition. So additional observations from established test sites will supplement previously obtained signature information. Finally, all these data will be normalized so that an analog computer in the spacecraft can "precondition" the spectral signature as a function of the many variables.

In forestry, remote sensing is in regular use, and research continues on additional applications. For fire control, USDA's Forest Service employs an airborne thermal infrared scanning system that permits instantaneous and precise mapping of firelines, day or night, and through dense smoke. And airborne sensors also detect and map forest insect infestations and differentiate hardwoods and conifers for inventories of timber resources.

In agriculture, research has developed an impressive list of capabilities for remote collection and automatic processing of data. Among them:

- Classifying land by major use category—bare soil, green vegetation, forests, and water—through multispectral techniques and automatically processing the data.
- Delineating earth characteristics with very high altitude color infrared photography that penetrates atmospheric haze and brings out details not normally evident on ordinary color or black-and-white photos.
- Identifying by amount of reflectance and thermal radiation the signatures of up to 10 species of crops and simultaneously interpreting the data over regions of 5 and 65 square miles (and during the 1969 growing season to be tested over 500-square-mile areas).
- Determining changes in crop development or acreage over time by comparing sequential photos taken at the same location on two or more occasions.
- Detecting with color infrared photography those plants stressed by mineral deficiency, salinity, disease, or insect infestations. The cause of stress must be determined by man at the site; remote sensors indicate conditions at variance with the norm, sometimes before they can be seen on the ground.
- Determining quantitatively the boundaries of surface soils or of areas possessing similar surface characteristics, and analyzing and reducing the data by automatic recognition techniques for production of highly accurate reconnaissance maps.
- Measuring radiant temperatures of soils and obtaining automatic computer printouts of the information.
- Utilizing radar (microwave) imagery for study of land forms and predicting agricultural land use.
- Obtaining data from unmapped regions and correcting ground-survey maps with radar, which can "see" even though the earth is continuously hidden under dense cloud cover.
- Detecting and delineating boundaries of water on agricultural land areas as large as 500 square miles and automatically processing data by such computer techniques as spectrum matching and automatic pattern recognition.
- Detecting and mapping thermal pollution of water and mapping bottom contours of streams and lakes.

Still other agricultural uses for remote sensing appear promising as research refines techniques for obtaining, in minutes or hours from aircraft or satellite, information that can be assembled on the ground only by painstaking effort over weeks or years, if at all. ■

microwave BBQ

MICROWAVE OVENS may one day replace conventional methods for retail barbecuing of meats and poultry—and do the job more than three times faster.

The number of retail establishments selling barbecued meat and poultry has more than tripled during the past 10 years. Barbecued products, noted for their flavor, are cooked either by gas or electric ovens or by infrared lamps. Then the smoky flavor is imparted by numerous types of heating-smoking units burning hardwood chips, sawdust, or wood logs. Some establishments use the units for both cooking and smoking. These methods are time-consuming and cumbersome.

Researchers at Southern University, Baton Rouge, La., working under an ARS contract, found that microwaves can do the job quickly and easily. Microwaves are electromagnetic radiation between radio waves and infrared radiation on the spectrum band. Most foods have comparatively high resistance to microwaves and are rapidly heated by their passage.

The researchers compared microwave oven-smoking and conventional hardwood coal barbecuing on fresh pork, ham, beef, and chicken. Chemist W. B. Robinson was investigations leader.

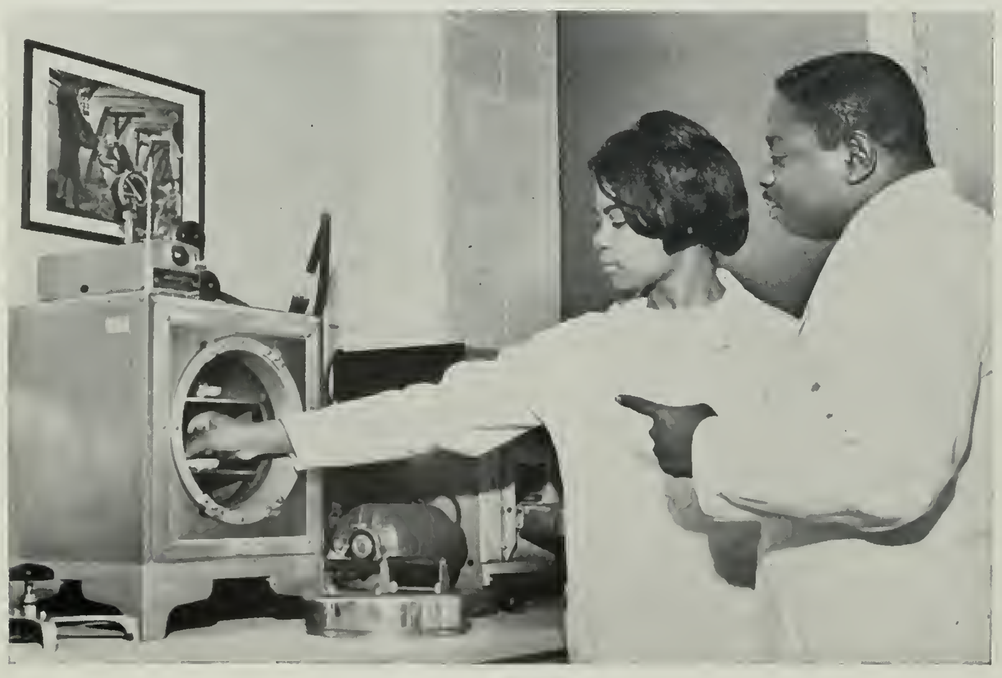
Actual cooking time by microwave was only 3 minutes per pound for spare ribs and chicken halves, 5 minutes for beef brisket, and 6 minutes for fresh ham.

Pieces cooked by microwave were smoked in a separate unit, while those barbecued over coals were smoked during cooking. Combined cooking and smoking time per pound by the microwave technique was one-third or less than for conventional methods.

A trained taste panel rated all meats barbecued by microwaves as good as meats cooked over hardwood coals. The microwave cooked meats, however, showed lower moisture and ether extract percentages, and a 4- to 10-percent increase in total barbecuing losses. There was also a 4- to 8-percent weight loss, probably reflected by the moisture and ether extract loss.

Frozen storage did not change the quality of pork, ham, and beef barbecued by both methods. These meats lost neither color nor smoky flavor after 3 months storage at −13° C. Chicken, however, did. The broiler halves barbecued by both methods showed a significant decrease in both color and taste after undergoing the same storage conditions. ■

Robinson and technician Emma Anderson place meat sample in vacuum oven which extracts moisture for analysis (PN–1799).



Temperature of sample cooked in microwave oven is measured (PN–1798).

doubled dip cuts fruit decay

A QUICK hot water-fungicide dip could help cure some of the postharvest decay that is causing increasingly serious losses to growers and packers of peaches, plums, and nectarines.

Postharvest rots were the major reason for a 15- to 24-percent marketing loss of our peaches, and they destroyed up to 7 percent of some plum shipments in 1968. Nectarines are also highly susceptible to rots.

Decay can strike at any time during marketing, but most losses occur after costly storage and transit when the seemingly wholesome fruit is transferred to ripening temperature at its destination.

Some packers have reduced decay by dipping the fruit in hot water (AGR. RES., Nov. 1966, p. 3) or in fungicide. The combined hot water-fungicide treatment developed by ARS researchers in California, however, generally controlled decay in preliminary tests more effectively than either fungicide or hot water alone.

Furthermore, the dip takes only 1 to 1½ minutes compared to plain hot water treatments that require 3 minutes. The dip leaves less residue than fungicide alone and overcomes the problem of fruit injury in some late-maturing varieties of peaches and nectarines caused by 3-minute hot water treatments.

Using DCNA (2,6-dichloro-4-nitroaniline) fungicide, plant pathologists J. M. Wells and J. M. Harvey in Fresno found that hot DCNA treatments reduced decay in peaches and nectarines from a mean of 65 percent in untreated lots to 7 to 14 percent. For example, a 1.5 minute treatment with 225 parts per million DCNA at 125° F. reduced decay to a mean of 7.8 percent and caused no injury to the fruit.

Plums required longer exposure or higher DCNA concentrations. A 1½ minute treatment at 125° with 450 ppm DCNA reduced decay to a mean of 3.8 percent, compared to a mean of 14.8 percent in untreated lots.

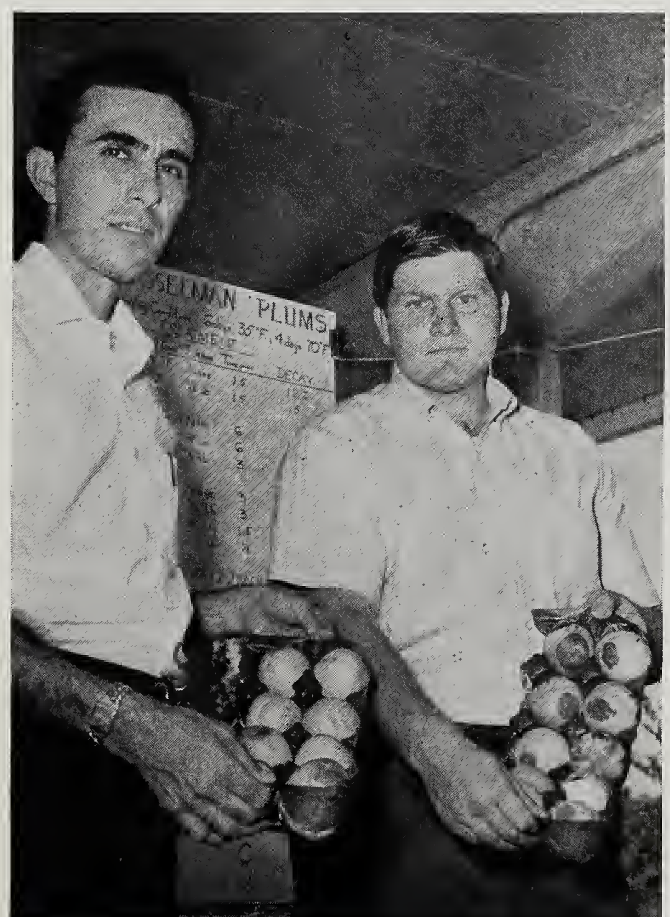
With 125° water alone, 1½ minute treatments reduced decay in peaches and nectarines to a mean of 17.2 percent and reduced decay in plums to a mean of 12.6 percent. Relatively low levels of hot DCNA were more effective in decay control than 900 ppm DCNA in unheated water.

For these laboratory tests, the scientists used naturally-infected fruits. After the treatment the fruit was held 2 to 3 weeks at 35° and ripened 5 to 7 days at room temperature under high humidity.

Pilot-model equipment for the hot fungicide dip is now being tested under commercial packing shed conditions.

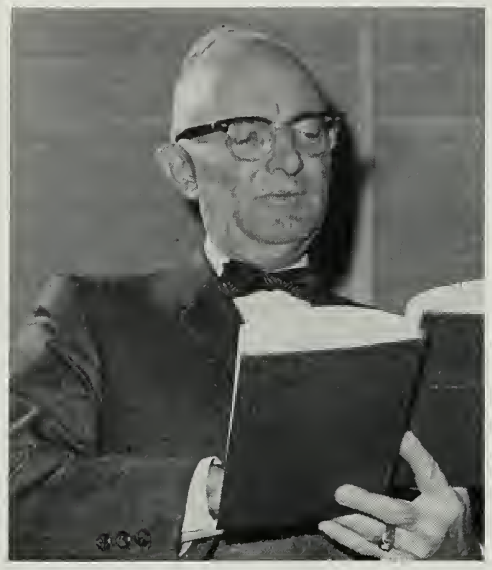
Residues on nectarines and plums treated in 225 ppm hot DCNA were about 3 ppm. Residues on similarly treated peaches were 12 ppm.

The Food and Drug Administration has established 20 ppm as the permissible DCNA residue level for peaches treated after harvest. Postharvest applications of DCNA, however, have not been approved for nectarines or plums. ■



Left: *Wells, left, holds nectarines that escaped brown rot by being dipped in hot fungicide solution; technician John Armstrong holds tray of untreated nectarines (PN–1801).* ***Above:*** *Wells and Armstrong dip a sample lot of nectarines into heated water. Commercial versions of the tank will hold over 2,000 gallons of water (PN–1800).*

Distinguished and Superior Service Awards



George W. Irving, Jr. (ST-3176-1)

Gustav A. Wiebe (ST-4581-2)

William J. Zaumeyer (ST-4933-3)

For their outstanding achievements, 10 individuals and two groups of ARS employees recently received Distinguished and Superior Service Awards.

Secretary of Agriculture Clifford M. Hardin presented the awards at USDA's 23rd annual awards ceremony held May 20 at Washington, D.C.

FOR DISTINGUISHED SERVICE...

George W. Irving, Jr., *Administrator,* for unequalled efforts in the development and administration of effective scientific research on behalf of U.S. agriculture and the American consumer.

Gustav A. Wiebe, *Crops,* for application of scientific advances in crop improvement that led to hybrid barley and barley with improved nutritional quality.

William J. Zaumeyer, *Crops,* for achievements in plant pathology and breeding that led to improved peas and beans for the United States and countries where legumes are the primary source of protein in the human diet.

FOR SUPERIOR SERVICE...

John G. Bowne, *Animal Disease and Parasite,* for leadership in research on bluetongue disease of cattle and sheep, a virus disease transmitted by a tiny blood-sucking gnat.

William B. Ennis, Jr., *Crops,* for his understanding of weed, nematode, and plant disease problems that led to solutions of many problems by scientists under his leadership.

Theodor O. Diener, *Crops,* for identifying a radically new type of virus and developing a greater understanding of plant virus-host interactions.

Joseph Naghski, *Eastern Utilization,* for leadership of the research program that led to more servicable leathers and the increased use of hides and skins.

Lambertus H. Princen, *Northern Utilization,* for research that solved practical problems in linseed oil paints that had kept them from competing with latex paints for outdoor use.

Russell L. Stedman, *Eastern Utilization,* for his leadership in planning and performing complex studies designed to clarify relationships between smoking and health.

Robert E. Wester, *Crops,* for the development of improved disease-resistant lima bean varieties that literally saved the industry in the Eastern United States.

Flame Resistant Cotton Group, *Southern Utilization,* for the discovery of a flame retardant for lightweight cottons which does not cause loss of tensile strength or hand.

Puerto Rico Project, *Soil and Water Conservation,* for raising productivity of steep lands, developing management systems for intensive crop production in humid tropics, and contributing leadership to Latin American agricultural agencies. ■

AGRISEARCH NOTES

Surface Bond Holds Concrete Blocks

A boy stacking blocks in a playpen may use the same skills later to build himself a house if ARS-developed building techniques pan out.

One promising method of construction under study at Athens, Ga., is surface bonding of concrete blocks, eliminating the use of mortar. Blocks are stacked dry, and a surface bonding mix is troweled on both sides of the wall. The bonding mix goes on almost as fast as painting of a similar surface. An unskilled person can soon learn to apply the mix.

Even with skilled labor, a saving of about 25 percent in total cost is possible when compared with conventional block laying because of the reduced labor needs and lower material cost.

Strength of the joints is three or more times greater than regular mortar even though thin coats, $\frac{1}{16}$ inch or less, are applied. The mix is essentially a cement grout with other ingredients added to improve plasticity, reduce settling time, and improve water resistance qualities. Strength is gained by adding $\frac{1}{2}$-inch lengths of chopped fiber glass filaments.

A fringe benefit of the new method is that the coating covers all cracks, and cleaning is easy. Just enough troweling is required to provide a firm bond with the block surface. And with some glass fibers only partially embedded, a pleasing surface texture is produced. The use of white cement in the bonding mix will permit the addition of mineral coloring.

ARS agricultural engineers J. W. Simons and B. C. Haynes are presently trying to develop mechanical equipment to further reduce the labor cost of applying the mix.

Exotic Corn Imparts Strong Roots

Mexican corn varieties, commonly called "exotics," offer an exciting source of new genes for improving corn root strength.

ARS agronomist D. L. Thompson, working with North Carolina Agricultural Experiment Station scientists, is attempting to breed the strong root characteristics of exotics into popular North Carolina types, thus reducing the yield losses caused by poor-rooted corns which tend to lodge.

For the past 5 years, the scientists have compared roots using the root clump method—a system by which ratings from 1 (small) to 5 (large) are assigned to the varying root clump sizes. In tests at Plymouth and Rocky Mount, N.C., in which the scientists compared 157 adapted hybrids with 9 exotics, the hybrids had an average root clump rating of 2.9 while the exotics had an average of 4.4.

Field weights of root clumps are slightly more accurate than the visual ratings but much more work is involved. The visual ratings are, however, very closely correlated with weights and are satisfactory for most breeding work.

Breeding and selection experiments for the past 5 years suggest at least partial success in transferring genes for large root clump size from the exotics to local adapted types. Another 5 years, hopefully, will provide more conclusive results.

Concrete block walls are stacked dry; then, the surface bonding mix is applied (PN–1802).

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AGRISEARCH NOTES

Nutrients in Irrigation Water

Irrigators drawing waters from the Snake River or Salmon Falls and Roseworth Reservoirs in the Magic Valley of Idaho should not make allowances for nitrogen and phosphorous in the water when figuring their fertilizer needs.

ARS studies show that the amounts of those two minerals is too small to be important sources for plants.

Potassium and sulfur are a different story, however. There is enough potassium in the water to take care of most crop needs, and the sulfur supply is more than is needed for anything grown in the Magic Valley.

These findings resulted from a study of the nutrient quality of Magic Valley irrigation waters by ARS soil scientist D. L. Carter at the Snake River Conservation Research Center, Kimberly, Idaho. The Idaho Agricultural Experiment Station cooperated in the work.

Potato Storage Plans Available

ARS guidelines for constructing new potato storage facilities can save the potato industry some $35 million over a 5-year period, and provide consumers with better quality potatoes.

Plans and specifications have been developed by ARS engineers for four types of storages for the fall-crop areas of the United States. Plan 5979 is for a 60,000 hundredweight (cwt.) door-per-bin type; Plan No. 5989 is for a 20,000 cwt. arched roof storage; Plan No. 6018 is for a 60,000 cwt. cross alley building; and Plan No. 6038 is for a 60,000 cwt. pallet box facility.

The plans, available from extension agricultural engineers at land-grant universities, include full information, ranging from site preparation to plumbing, heating, drainage, and sewage disposal.

Information also is provided on other publications dealing with improved equipment and methods, and on facilities for handling, storing, and packing potatoes.

Separating Seeds—Magnetically

Iron powder, water, and the surface characteristics of seeds permit agricultural engineers to separate crop and weed seeds magnetically.

Many crop seeds are smooth or waxy-surfaced while weed seeds and contaminants often are rough or sticky. That peculiarity helps make a magnetic separation process work.

When iron powder and moisture are mixed with seed lots, rough or sticky components pick up the powder, while smooth or waxy ones do not. The two can be separated by passing the treated lot over a magnetic drum where the iron-coated material is attracted to the drum, pulled out of the mixture, and discharged separately from the smooth, uncoated fraction. The process can also be used to remove damaged seed along with the contaminants.

Crop seeds that can be cleaned on magnetic separators include small legumes like alfalfa, clover, lespedeza, and trefoil; also other smooth seeds like flax and timothy. Typical contaminants removed are dodder, buckhorn plantain, sorrel, skinned dock, wild geranium, knapweed, mallow, whitetop, hulled Johnson grass, broken seed, dirt clods, and trash. Most common separations in the United States are dodder and buckhorn plantain from alfalfa and red clover.

Magnetic separation is being studied by ARS agricultural engineer N. R. Brandenburg at Corvallis, Oreg., in cooperation with the Oregon Agricultural Experiment Station.

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